PATENT ABSTRACTS OF JAPAN

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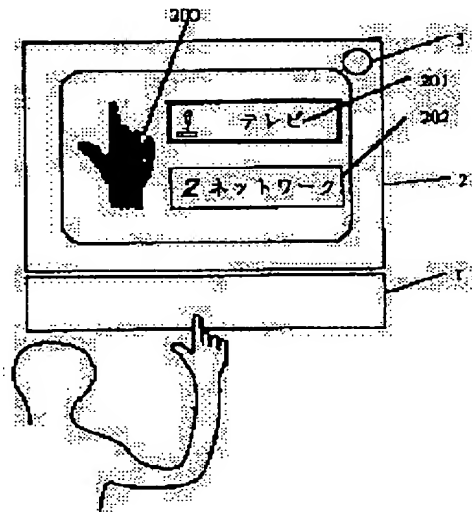   MORIIE MICHIYO
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(54) INTERFACE DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To improve operability by easily operating equipment without requiring any input device such as keyboard or mouse by displaying the feature of shape of a hand recognized by a recognizing means on a screen as a special shape.
SOLUTION: When a user projects one finger while facing equipment provided with an interface device, the icon of numeral '1' is displayed on a display 2 and the television of 1st menu 201 is displayed while being emphasized. At such a time, it is also available to output a sound or a voice from the display device 2 corresponding to the emphasized indication. In this case, when the user changes the shape of the hand to project two fingers, the icon of numeral '2' is displayed on the display 2 and the network of 2nd menu 202 is displayed while being emphasized. By keeping the same shape of the hand for a fixed time in such a state, for example, the 2nd menu 202 is selected and it can be commanded to a host computer 1 to perform the display of network terminal.

* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] The interface device equipped with a recognition means to recognize the configuration of an operator's hand, a display means to display on a screen by making into a special configuration the description of the configuration of the hand recognized by said recognition means, and the control means that controls the information displayed in said screen by the special configuration displayed on the screen by said display means.

[Claim 2] The interface device according to claim 1 which a recognition means displays on a screen by making into a special configuration the configuration of the hand that have recognized the motion of said hand with the configuration of a hand, and the display means has been recognized by said recognition means, and the description of a motion.

[Claim 3] The interface device according to claim 1 controlled so that a control means chooses the information displayed in the screen.

[Claim 4] The interface device characterized by providing the following It is the image pick-up section at least. the configuration of the body in the picturized image -- and -- or the recognition section of operation which recognizes a motion the configuration of the body recognized by said recognition section of operation -- and -- or the frame memory which saves the image which was equipped with the display which displays a motion and was picturized in said image pick-up section Image difference operation part which prepares the criteria image memory which accumulates the image picturized to the time amount before the image saved in said frame memory as a criteria image, and extracts the difference between the image in said frame memory, and the criteria image accumulated into said criteria image memory in said recognition section of operation

[Claim 5] The interface device according to claim 4 which prepared the renewal section of a criteria image which updates the criteria image accumulated into criteria image memory in a new image.

[Claim 6] The interface device according to claim 4 which formed the timer which calculates spacing of renewal of a criteria image in the renewal section of a criteria image.

[Claim 7] the configuration of the hand of the user in the image picturized with the image

pick-up section at least -- and -- or with the recognition section of operation which recognizes a motion the configuration of the hand of the user who has recognized by said recognition section of operation -- and -- or it having the display which displays a motion and with a profile extract means to extract a user's picturized profile The profile wave operation part which pursues said profile and calculates the relation between the include angle of a border line, and the die length of a border line, i.e., a profile wave, The interface device which filtered the profile wave calculated by said profile wave operation part, prepared the configuration filter which generates the configuration wave showing a predetermined configuration, and constituted said recognition section of operation.

[Claim 8] The interface device according to claim 7 it was made to make actuation of a user judge based on the configuration wave which constituted two or more configuration filters with two or more band pass filters with which bands differ, and was generated with said two or more configuration filters.

[Claim 9] The interface device according to claim 7 which constituted two or more configuration filters at least with the band pass filter of the profile wave configuration corresponding to the irregularity of a hand, and the band pass filter of the profile wave configuration corresponding to the irregularity of a finger.

[Claim 10] The interface device according to claim 7 which prepared the coordinate of the profile configuration of the user who picturized, and the coordinate table which makes correspondence with the profile wave calculated by profile wave operation part memorize, prepared the coordinate operation part which calculates the coordinate in which the predetermined configuration in an image pick-up image exists using the wave height existence location and said coordinate table of a configuration wave, and constituted the recognition section of operation.

[Claim 11] The interface device according to claim 7 prepare [interface device] the configuration judging section which counts the pulse number in the configuration wave generated with the configuration filter, constitute [interface device] the recognition section of operation, and it was made to make an objective configuration judge with the output value of said configuration judging section.

[Claim 12] The interface device according to claim 7 which formed the differentiator which differentiates the configuration wave generated with the configuration filter, and constituted the recognition section of operation.

[Claim 13] The interface device characterized by providing the following Display means An input means to change the location and configuration of cursor which are displayed on said display means A cursor storage means to memorize the configuration of the representation point coordinate representing the location of said cursor, and said cursor A body storage means to memorize the configuration of the representation point coordinate representing the location of display objects other than said cursor, and said display body, The location and

configuration of a display object which are memorized for the location and the configuration, and said body storage means of the cursor memorized for said cursor storage means are used. It has an interaction judging means to judge the interaction between said cursor and said display objects. Said interaction judging means A distance count means to calculate the distance between the representation point of said cursor of at least one point, and the representation point of said display object of at least one point, A comprehensive judgment means to opt for the interaction of said cursor and said display object using the recognition result of a recognition means of operation to recognize migration of said cursor, or change of a configuration, and the distance which said distance count means calculates and said recognition means of operation

[Claim 14] The interface device according to claim 13 characterized by an interaction judging means generating an interaction to the display object below the criteria which the distance which a distance count means calculates defined beforehand when the recognition means of operation has recognized the actuation registered beforehand.

[Claim 15] The interface device according to claim 13 characterized by for an interaction judging means to opt for the interaction of said cursor and display object based on the migration direction of the cursor which establishes a movement vector calculation means to compute the migration direction and movement magnitude of cursor in an operating space, and constitutes an interaction judging means, and said migration direction calculation means computes, and the movement magnitude of cursor.

[Claim 16] The interface device according to claim 15 characterized by an interaction judging means generating an interaction when the movement magnitude of the cursor which a movement vector calculation means computes is below the reference value defined beforehand.

[Claim 17] The interface device according to claim 15 characterized by an interaction judging means generating an interaction to the display object which exists near the production of the migration direction of the cursor which a movement vector calculation means computes.

[Claim 18] The interface device according to claim 13 characterized by an interaction judging means generating an interaction when the configuration of cursor and the configuration of a display object become the combination registered beforehand.

[Claim 19] The interface device according to claim 13 characterized by an interaction judging means generating an interaction about the case where the configuration of cursor and the configuration of a display object which are equipped with a configuration judging means to recognize a cursor configuration and the configuration of a display object, and constitute an interaction judging means, and said shape-recognition means recognizes are in agreement.

[Claim 20] The interface device according to claim 13 characterized by an interaction judging means generating an interaction when the actuation which the recognition means of operation registered beforehand has been recognized to the display object near the production top of the look which establishes a look input means to detect the direction of a look, and said

look input means detects.

[Claim 21] The interface device according to claim 20 characterized by an interaction judging means generating an interaction when the actuation which cursor existed near the production top of said look, and the recognition means of operation registered beforehand has been recognized to the display object near the production top of the look which a look input means detects.

[Claim 22] The interface device according to claim 13 characterized by establishing a study means to learn the physical relationship of cursor and the target display object, the configuration of said cursor, and the configuration of said display object, and an interaction judging means opting for an interaction based on the study result of a study means when an interaction is generated.

[Claim 23] The interface device according to claim 22 characterized by an interaction judging means generating an interaction when the physical relationship of cursor and the target display object or the configuration of said cursor, and the configuration of said display object are similar with the physical relationship or the configuration which the study means learned in the past.

[Claim 24] The interface device according to claim 13 characterized by establishing a coordinate transformation means to perform coordinate transformation to the input from the cursor storage section and the body storage section to a distance count means, and constituting an interaction judging means.

[Claim 25] The interface device according to claim 24 characterized by performing coordinate transformation so that the physical relationship of cursor and the target display object may be made to approach when an interaction is generated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the interface device which outputs and inputs the device which has the display of information machines and equipment, such as a computer and a word processor, television, etc.

[0002]

[Description of the Prior Art] There are some which are performed by displaying cursor on the coordinate location detected with the mouse in the display screen although add some another information to the information in a display, or the information on a display is changed into it as this kind of a conventional interface device or being chosen.

[0003] Drawing 30 shows the outline of this kind of conventional interface device. In drawing 30 , 501 is a host computer, 502 is a display, and the manual operation button 503,504,505 of imagination is displayed with the host computer 501 during the display 502. 506 is a mouse cursor, and based on the movement magnitude of the mouse 507 detected with the mouse 507, a host computer 501 carries out a display control so that it may move all over a screen synchronizing with a motion of a mouse 507. By moving a mouse 507, by moving a mouse cursor 506 to the location of the manual operation button of imagination of the arbitration in a display screen, and pushing the switch 508 on a mouse 507, a user chooses a manual operation button and can give directions of operation to a host computer 501 now.

[0004]

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional configuration, apart from the body of a device, an input device called a mouse is required, and the pedestal of the table which operates a mouse is required, and using for a portable information device etc. is not suitable. Moreover, in order to operate it through a mouse, it is not necessarily a direct and intelligible interface.

[0005] In view of this point, this invention does not need input units, such as a keyboard and a mouse, but actuation of a device is simply possible for it, and its operability is further more good, and it tends to offer a direct and intelligible interface device.

[0006]

[Means for Solving the Problem] This invention with the special configuration displayed on the screen by recognition means to recognize the configuration of an operator's hand, display means to display on a screen by making into a special configuration the description of the configuration of the hand recognized by this recognition means, and this display means It is the interface device equipped with the control means which controls the information displayed in the screen, and the information displayed on the screen can be controlled only by

changing the configuration of a hand.

[0007] Furthermore, the good interface means of operability is further offered by recognizing a motion of a hand. The criteria image memory which accumulates the image picturized to the time amount before the image saved in the frame memory which saves the image which picturized the configuration of a hand or the motion at the motion recognition, and said frame memory as a criteria image is prepared, and it attains by extracting the difference between the image in a frame memory, and the criteria image accumulated into criteria image memory. moreover, the configuration of the hand of the user in the image picturized as other recognition approaches -- and -- or the motion was extracted as a user's profile, the profile was pursued, and it has attained by generating the configuration wave which calculates and filters the relation between the include angle of a border line, and the die length of a border line, i.e., a profile wave, and expresses a predetermined configuration.

[0008] Furthermore, the cursor display means for displaying on a screen by making the description of the configuration of a hand into a special configuration, and operating it as cursor, A means to memorize relation with display objects other than the cursor display as the representation point coordinate and the configuration of representing the location of display objects other than a cursor display, The means which carries out the operation judging of the interaction between a cursor display and said display object is established, and when imagination manipulator-izes a cursor display and it displays it, and holding the displayed virtual body, actuation can be smoothly realized by the interaction in alignment with an intention of an operator.

[0009] If a user tends toward a recognition means, for example, the interface device constituted as mentioned above holds up a hand, the icon display for the so-called menu manipulation will be made in a screen, and the special configuration equivalent to the configuration of a hand will become controllable [according to the icon display].

[0010] Or if directions are given according to a gesture, while the special configuration in which the given gesture was set up on the display screen corresponding to the configuration of a hand will be displayed Choose the virtual switch which the motion was also displayed, for example, was displayed on the display screen according to a gesture, or [for the purpose of the display object displayed on the screen], it cannot hold, cannot carry, or cannot carry out, and input units, such as a mouse, are not needed, but actuation of a very simple device is attained.

[0011] Moreover, the special configuration set up corresponding to the configuration of a hand operates as a virtual manipulator in addition to mere cursor, and the interface whose operability improved further can be realized by making serially the judgment which suited the actuation intention of an operator automatically in an interaction with a display object operating with a virtual manipulator. .

[0012]

[Embodiment of the Invention]

(Gestalt of the 1st operation) The 1st operation gestalt of this invention A display means to display the description of the configuration of the hand recognized by a recognition means and these recognition means, such as image pick-up equipment, in order to recognize the configuration of an operator's hand on a screen as a special configuration by an icon etc., It is the interface device equipped with the control means which controls the information which special configurations, such as an icon displayed on the screen by this display means, were operated as the so-called cursor, and was displayed in the screen by changing the configuration of a hand.

[0013] (Gestalt of the 2nd operation) The 2nd operation gestalt of this invention the configuration of the body in the image picturized with the image pick-up section at least ·· and ·· or with the recognition section of operation which recognizes a motion the configuration of the body recognized by this recognition section of operation ·· and ·· or the display which displays a motion constituting and with the frame memory which saves the image picturized in said image pick-up section The criteria image memory which accumulates the image picturized to the time amount before the image saved in this frame memory as a criteria image is prepared. In the recognition section of operation The image in a frame memory, It is the interface device which prepared the image change extract section which extracts a difference with the criteria image accumulated into criteria image memory.

[0014] (Gestalt of the 3rd operation) The gestalt of operation of the 3rd of this invention the configuration of the hand of the user in the image picturized with the image pick-up section at least ·· and ·· or with the recognition section of operation which recognizes a motion the configuration of the hand of the user who has recognized by this recognition section of operation ·· and ·· or it having the display which displays a motion and with a profile extract means to extract a user's picturized profile The profile wave operation part which pursues this extracted profile and calculates the relation between the include angle of a border line, and the die length of a border line, i.e., a profile wave, It is the interface device which filtered the profile wave calculated by this profile wave operation part, prepared the configuration filter which generates the configuration wave showing a predetermined configuration, and constituted said recognition section of operation.

[0015] If a user goes to the image pick-up section of the interface device constituted as mentioned above, for example, directions are given according to a gesture, the image pick-up section will picturize a user's image. A profile extract means extracts the profile of a user's image, and this profile is changed as the include angle of the border line to a horizontal line, i.e., a profile wave, by setting an axis of abscissa as the die length of the border line which made the reference point on a profile the start point by profile wave operation part. This profile wave is changed into the configuration wave which expresses the shape of toothing of a finger with the configuration filter constituted with the band pass filter of a predetermined band, for example, the band pass filter equivalent to the irregularity of a finger, while it

calculates a location with a hand, only counts the pulse number which exists in this configuration wave, and can make the number of the finger currently sent, i.e., the configuration of a hand, judge correctly. The virtual switch which the given gesture was displayed on the display screen of a display based on a location and a configuration of this sort, for example, was displayed on the display screen cannot be chosen according to a gesture, and input units, such as a mouse, are not needed, but actuation of a very simple device is attained.

[0016] Moreover, two or more band pass filters with which bands differ may constitute two or more configuration filters, and based on the configuration wave generated with said two or more configuration filters, you may constitute so that actuation of a user may be made to judge. Thereby, two or more configurations can be recognized now.

[0017] Moreover, the band pass filter of the profile wave configuration corresponding to the irregularity of a hand and the band pass filter of the profile wave configuration corresponding to the irregularity of a finger may constitute two or more configuration filters at least. It is changed into the smooth configuration wave only reflecting the irregularity of the part of a hand by this, and is changed into the configuration wave only reflecting the irregularity of ****.

[0018] Moreover, the coordinate of the profile configuration of the user who picturized, and the coordinate table which makes correspondence with the profile wave calculated by profile wave operation part memorize may be prepared, the coordinate operation part which calculates the coordinate in which the predetermined configuration in an image pick-up image exists may be prepared using the wave height existence location and said coordinate table of a configuration wave, and the recognition section of operation may be constituted. Thereby, the coordinate of a profile configuration calculates and the coordinate is outputted.

[0019] Moreover, the configuration judging section which counts the pulse number in the configuration wave generated with the configuration filter is prepared, the recognition section of operation is constituted, and you may make it make an objective configuration judge with the output value of said configuration judging section. The judgment of whether to be the configuration which grasped the hand for whether it is the configuration of 2 fingers with the pulse number by this is made easily.

[0020] Moreover, the differentiator which differentiates the configuration wave generated with the configuration filter may be formed, and the recognition section of operation may be constituted. By differential, a wave becomes pulse-like more and the count of a pulse number becomes easy.

[0021] (Gestalt of the 4th operation) Although the gestalt of old operation has described the example which operates it about the secondary screen displayed on the display screen, it requires the gestalt of this operation for the actuation at the time of displaying an imagination three dimension on the two-dimensional display screen. In the imagination three-dimension space generally displayed, if the actuation which holds the virtual body in a

virtual space using cursor is assumed, it will become the following configurations.

[0022] For an input unit and A2, in drawing 21 , the cursor coordinate storage section and A3 are [A1 / a display and A5 of the body coordinate storage section and A4] the contact decision sections. Drawing 22 shows the cursor of the manipulator configuration of two fingers which can be displayed from the configuration of an operator's hand like the gestalt of the already described operation. The condition that the condition to which drawing 22 (a), (c), and (e) opened the finger, drawing 22 (b), (d), and (f) closed the finger is shown. Drawing 23 shows the example of the virtual body in a virtual space. An operator assumes the actuation which holds the virtual body in virtual three-dimension space using the cursor of two fingers here. Drawing 24 (a) and drawing 24 (b) show arrangement of the cursor in the virtual space when holding a virtual body using cursor, and a virtual body. Drawing 25 shows the display of display A4.

[0023] If actuation of an operator is given to the input section A1, spacing of the cursor coordinate memorized in the cursor coordinate storage section A2 and two fingers of cursor will be updated based on said actuation. Display A4 draws the virtual space which contains cursor and a virtual body using the positional information of the virtual body which the information which the cursor coordinate storage section A2 memorizes, and body coordinate storage section A3 memorize. Here, cursor and a virtual body calculate whether it contacts in a virtual space using the positional information of the virtual body which the information the cursor coordinate storage section A2 remembers contact decision section A5 to be, and body coordinate storage section A3 memorize. If the distance in the virtual space between two or more fields which constitute cursor and a virtual body is specifically calculated about between each field and a virtual body contacts between two fingers of cursor, it will judge that cursor has held the virtual body and an objective coordinate will be henceforth changed in accordance with migration of cursor.

[0024] However, by such technique, even when in arrangement as shown in drawing 24 (a) and (b) the display by the display becomes like drawing 25 and the location of cursor and a virtual body is not completely in agreement in a virtual space, an operator may incorrect-judge that the coordinate is in agreement. Moreover, it becomes difficult [a display which wrote together the case where three-dimensional display equipment is used, drawing 24 (a), and (b)] from the difference in the depth perception in real space and a virtual space smooth to operate it.

[0025] Thus, the interaction (a virtual body is held in the aforementioned example) which met the intention of an operator in the interaction of cursor and the virtual body in a virtual space can be smoothly realized neither according to the difference between the depth perception in the imagination space which is an operating space, and the depth perception in real space, nor the difference between a motion of the cursor which an operator means, and a motion of actual cursor (for example, when holding a virtual body with the manipulator of imagination

etc.).

[0026] With the gestalt of this operation, while operability is improved by cursor control in non-contact [with a gesture etc.] in an operator in a virtual space Only the distance between the cursor in a virtual space and the component (it is a front face when a virtual space is a three dimension) of a virtual body does not determine the existence of generating of an interaction with the virtual body in a virtual space. The judgment of whether cursor causes a virtual body and an interaction can be brought close to an intention of an operator, and the operability of an interface can be further raised because an interaction judging means causes an interaction also to the object with which the distance in a virtual space is not necessarily close. Furthermore, it becomes possible to cause an interaction also to the object with which the distance in a virtual space is not necessarily close.

[0027] An input means by which the 1st configuration of the gestalt of this operation changes the location and configuration of cursor of displaying on a display means and said display means, A cursor storage means to memorize the configuration of the representation point coordinate representing the location of said cursor, and said cursor, A body storage means to memorize the configuration of the representation point coordinate representing the location of display objects other than said cursor, and said display body, The location and configuration of a display object which are memorized for the location and the configuration, and said body storage means of the cursor memorized for said cursor storage means are used. It constitutes from an interaction judging means to judge the interaction between said cursor and said display objects. Said interaction judging means A distance count means to calculate the distance between the representation point of said cursor of at least one point, and the representation point of said display object of at least one point, It is the interface device characterized by consisting of a recognition means of operation to recognize migration of said cursor, or change of a configuration, and a comprehensive judgment means to opt for the interaction of said cursor and said display object using the recognition result of the distance which said distance count means calculates, and said recognition means of operation.

[0028] By this configuration, the existence of generating of the interaction of the cursor which an operator operates in a virtual space, and the virtual body in a virtual space Only the distance between said cursor in a virtual space and the component (it is a front face when a virtual space is a three dimension) of said virtual body does not determine. When a comprehensive judgment means judges the existence of generating of an interaction by actuation of the cursor which the distance and the recognition means of operation between the representation points which a distance count means computes recognize, it becomes possible to cause an interaction also to the object with which the distance in a virtual space is not necessarily close.

[0029] Moreover, in the 1st configuration, when the actuation which the recognition means of operation registered beforehand has been recognized, it is good also as the 2nd configuration

an interaction judging means generates [configuration] an interaction to the display object below the criteria which the distance which a distance count means calculates defined beforehand.

[0030] Moreover, it is good also as the 3rd configuration whose interaction judging means opts for the interaction of said cursor and display object based on the migration direction of the cursor which sets in the 1st and 2nd configuration, establishes a movement-vector calculation means compute the migration direction and the movement magnitude of cursor in an operating space, and constitutes an interaction judging means, and said migration direction calculation means computes, and the movement magnitude of cursor.

[0031] Moreover, in the 3rd configuration, when the movement magnitude of the cursor which a movement vector calculation means computes is below the reference value defined beforehand, an interaction judging means is good also as the 4th configuration which generates an interaction.

[0032] Moreover, in the 3rd and 4th configuration, it is good also as the 5th configuration an interaction judging means generates [configuration] an interaction to the display object which exists near the production of the migration direction of the cursor which a movement vector calculation means computes.

[0033] Moreover, in the 1st - the 5th configuration, when the configuration of cursor and the configuration of a display object become the combination registered beforehand, an interaction judging means is good also as the 6th configuration which generates an interaction.

[0034] Moreover, in the 1st - the 6th configuration, an interaction judging means is good also as the 7th configuration which generates an interaction about the case where the configuration of cursor and the configuration of a display object which are equipped with a configuration judging means to recognize a cursor configuration and the configuration of a display object, and constitute an interaction judging means, and said shape-recognition means recognizes are in agreement.

[0035] Moreover, in the 1st - the 7th configuration, when the actuation which the recognition means of operation registered beforehand has been recognized to the display object near the production top of the look which establishes a look input means to detect the direction of a look, and said look input means detects, an interaction judging means is good also as the 8th configuration which generates an interaction.

[0036] Moreover, in the 8th configuration, when the actuation which cursor existed near the production top of said look, and the recognition means of operation registered beforehand has been recognized to the display object near the production top of the look which a look input means detects, an interaction judging means is good also as the 9th configuration which generates an interaction.

[0037] Moreover, in the 1st - the 9th configuration, when an interaction is generated, it is good

also as the 10th configuration whose interaction judging means establish a study means to learn the physical relationship of cursor and the target display object, the configuration of said cursor, and the configuration of said display object, and opts for an interaction based on the study result of a study means.

[0038] Moreover, in the 10th configuration, when the physical relationship of cursor and the target display object or the configuration of said cursor, and the configuration of said display object are similar with the physical relationship or the configuration which the study means learned in the past, an interaction judging means is good also as the 11th configuration which generates an interaction.

[0039] Moreover, in the 1st · the 11th configuration, it is good also as the 12th configuration which establishes a coordinate transformation means to perform coordinate transformation to the input from the cursor storage section and the body storage section to a distance count means, and constitutes an interaction judging means.

[0040] Moreover, in the 12th configuration, when an interaction is generated, it is good also as the 13th configuration which performs coordinate transformation so that the physical relationship of cursor and the target display object may be made to approach.

[0041] (The 1st example) Drawing 1 shows the appearance of the 1st example of the interface device by this invention. In drawing 1 , the display which uses 1 for a host computer and uses 2 for a display, and 3 are CCD cameras which picturize an image. CCD camera 3 arranges the image pick-up side in the same direction as the display direction of a display 2, and when a user goes to the screen, it can picturize the shape of a user's note. On a display 2, the icon 200 which performs the display reflecting a menu 201,202 and the shape of said note can be displayed now.

[0042] Drawing 2 shows the detail block diagram of this example. The image inputted from CCD camera 3 is stored in a frame memory 21. In the criteria image memory 25, the image of the background which does not contain the person picturized beforehand is saved as a criteria image. A criteria image can be updated at any time if needed.

[0043] While the configuration discernment means 22 removes a background image out of an image by extracting the difference of the image stored into the frame memory 21, and the image saved in the criteria image memory 25 for example, it is the configuration of 1 finger as extracts the part equivalent to a user's hand and the configuration shows to drawing 3 (a) ·· moreover, it is the configuration of 2 fingers as shown in drawing 3 (b) ·· or it judges whether other than this, it is drawing 3 (c).

[0044] Drawing 4 is what showed the gestalt of detail operation of the configuration discernment means 22, and shows the example constituted by the image difference operation part 221, the profile extract section 222, and the configuration discernment section 223. Image difference operation part 221 As mentioned above, the difference of the image stored into the frame memory and the image saved in criteria image memory is calculated. Thereby,

the parts of a body, for example, a user, to extract and a background are separable. For example, image difference operation part 221 When constituted from a simple subtraction circuit, as shown in drawing 5 , only the part of the hand of the user in the image in a frame memory can be extracted. The profile extract section 222 is the image difference operation part 221. The profile configuration of the body which exists in the image of the calculated result is extracted. As a concrete example of an approach, a profile configuration can be easily extracted by extracting the edge of an image.

[0045] It judges whether the configuration discernment section 223 is the configuration of 2 fingers where it is shown in drawing 3 (b) again whether it is the configuration of 1 finger as carries out detail discernment of the profile configuration of a hand, for example, the configuration shows to drawing 3 (a) extracted by the profile extract section 222. It is possible to use template matching, the matching technique with a geometric model, a neural network, etc. as a method of identifying a configuration.

[0046] The icon generation section 24 is the configuration discernment section 223. Based on the discernment result of the configuration of the hand to depend, an icon image is generated as a special configuration which should be displayed on a display. for example, ·· a hand ·· a configuration ·· discernment ·· a result ·· one ·· a ** ·· a finger ·· a configuration ·· it is ·· if ·· for example ·· drawing 6 ·· (·· a ··) ·· being shown ·· as ·· a figure ·· " ·· one ·· " ·· an icon ·· generating ·· moreover ·· two ·· a ** ·· a finger ·· a configuration ·· it is ·· if ·· for example ·· drawing 6 ·· (·· b ··) ·· being shown ·· as ·· a figure ·· " ·· two ·· " ·· an icon ·· generating . A 2 finger type icon if it is the configuration of 2 fingers again, as shows a 1 finger type icon if the discernment result of the configuration of a hand is the configuration of 1 finger as a configuration of an icon, as shown in drawing 6 (c) to drawing 6 (d) etc. may be generated. A display and control section 23 is the configuration discernment section 223. A display is controlled based on the discernment result of the configuration of the hand to depend. For example, while displaying said icon based on a discernment result, it displays by emphasizing the menu beforehand matched with the discernment result based on a note-like discernment result.

[0047] The example of actuation by this example constituted as mentioned above is shown below. If a user faces to the device equipped with the interface device of this example and a hand is made into the configuration of 1 finger, as shown in drawing 7 (a), while the icon of figure"1" will be displayed on a display, highlighting of the display of television which is the 1st menu is carried out. It is possible to call an operator's attention further with outputting a sound or voice from a display unit in accordance with highlighting at this time. Here, if a hand is made into the configuration of 2 fingers like drawing 7 (b), while the icon of figure"2" will be displayed on a display, highlighting of the display of the network which is the 2nd menu is carried out. The 2nd menu is chosen by maintaining the configuration of the same hand for example, during 1 scheduled time in this condition, and a command can be given so

that a network terminal may be displayed on a host computer. Voice etc. may be used together for selection of a menu. In except the configuration of the hand beforehand decided like drawing 7 (c), an icon and a menu are not displayed on a display, and an instruction is not sent to a host computer.

[0048] Thus, according to this example, it is possible to identify the configuration of the hand in the picturized image and to control devices, such as a computer, according to a discernment result, and it is possible to operate it by non-contact from remoteness, without using devices, such as a keyboard and a mouse. Moreover, positive actuation is attained that it can be operated while a user checks a discernment result by making the result of having identified the configuration of a hand reflect in a screen, and it is easy to use.

[0049] In addition, although this example showed the example only applied to menu selection, when an icon display sets ****** as a configuration with a hand beforehand so that a picture, a text, etc. may be replaced, it cannot be overemphasized that it is also easy to write a picture and an alphabetic character in a display and to control them.

[0050] (The 2nd example) Drawing 8 shows the appearance of the 2nd example of the interface device by this invention. In drawing 8 , the same numeric value shows a component to the part which has the same function as the 1st example. That is, the display which uses 1 for a host computer and uses 2 for a display, and 3 are CCD cameras which picturize an image. CCD camera 3 arranges the image pick-up side in the same direction as the display direction of a display 2, and when a user goes to the screen, it can picturize a user's gesture. On the screen of a display 2, the icon 203 of the arrow-head cursor which chooses the virtual switches 204, 205, and 206 and said virtual switch can be displayed now.

[0051] Drawing 9 shows the block diagram of the detailed configuration of the gestalt of this operation. The image inputted from CCD camera 3 is stored in a frame memory 21. In the criteria image memory 25, the image picturized beforehand is saved as a criteria image. A timer 261 and the renewal section 262 of an image constitute the renewal section 26 of a criteria image, it transmits the newest image saved at the frame memory 21 with the fixed time interval directed with a timer 261 to the criteria image memory 25, and updates a criteria image.

[0052] It judges whether the recognition section 22 of operation is the configuration of a fist where the part which is equivalent to a user's hand, for example is extracted, and the configuration shows drawing 10 (b) whether it is the configuration of 1 finger as shown in drawing 10 (a) again while removing a background image out of an image by extracting the difference of the image stored into the frame memory, and the image saved in criteria image memory.

[0053] Drawing 11 is what showed the detail of the recognition section 22 of operation, and shows the example constituted by the image difference operation part 221, the profile extract section 222, the form status change-ized discernment section 225, and the location detecting

element 224.

[0054] The image difference operation part 221 calculates the difference of the image stored into the frame memory 21 as mentioned above, and the image saved in the criteria image memory 25. While the part of the hand of a body, for example, a user, to extract as a motion and the part of a background are separable by this, only the body image which is moving can be extracted. For example, when the image difference operation part 221 is constituted from a simple subtraction circuit, as shown in drawing 12 , only the part of the hand in a criteria image and the part of the hand in the newest image in a frame memory can be extracted, and only the part of the hand which is moving can be identified easily. The profile extract section 222 extracts the profile configuration of the part of the hand the body which exists in the image of the result calculated by the image difference operation part 221, i.e., before moving, and after moving. As a concrete example of an approach, a profile configuration can be easily extracted by extracting the edge of an image.

[0055] It judges whether the form status change-ized discernment section 225 is the configuration of a fist where it is shown in drawing 10 (b) again whether it is the configuration of 1 finger as carries out detail discernment of the profile configuration of the part of the hand after moving, for example, the configuration shows to drawing 10 (a) extracted by the profile extract section 222. The location detecting element 224 calculates the barycentric coordinates of the profile configuration of the part of the hand of the user after [said] moving to coincidence.

[0056] The icon generation section 24 generates the icon image which should be displayed on a display based on the discernment result of the configuration of the hand by the form status change-ized discernment section 225. The icon of an arrow head if the discernment result of the configuration of a hand is the configuration of 1 finger as an example of an icon image, as shown, for example in drawing 13 (a) is generated, and if it is the configuration of a fist, the icon of X mark as shown, for example in drawing 13 (b) will be generated. Moreover, it is good also as a configuration which generates the icon of the configuration which imitated the configuration of 2 fingers as shown, for example in drawing 13 (c) when the discernment result of the configuration of a hand was the configuration of 2 fingers, and generates the icon of the configuration which imitated the configuration of a fist as shown, for example in drawing 13 (d) when it was the configuration of a fist.

[0057] A display and control section 23 controls the display position on the display 2 of the icon generated by the icon generation section 24, and consists of the coordinate transformation section 231 and the coordinate pars inflexa 232. The coordinate transformation section 231 performs conversion on the display coordinate of a display 2 of the picturized image from a coordinate, and the coordinate pars inflexa 232 reverses the right-and-left location of the changed display coordinate.

[0058] Namely, location detecting element 224 Conversion on the display coordinate of a

display 2 from the barycentric coordinates in the image of the part equivalent to the hand of the user who detected is performed, a coordinate on either side is reversed, and an icon is displayed on a display 2. By this actuation, if a user moves a hand to the right, the same with having copied this actuation in the mirror, an icon will go on the display screen and it will move to the right.

[0059] The example of actuation by this example constituted as mentioned above is shown below. As shown in drawing 8 , a user faces to the device equipped with the interface device by this example, and if it moves by making a hand into the configuration of 1 finger, the arrow-head cursor displayed on the display will move to the location of the arbitration corresponding to a motion of a hand. Next, when arrow-head cursor is moved, a hand is grasped and it is made a fist configuration by moving a hand after the virtual switch 204,205,206 of the arbitration displayed on the display 2, it is the virtual switch 204,205,206. It is chosen and a command can be given to a host computer 1.

[0060] In addition, although considered as the configuration which recognizes the configuration of the body in the picturized image, and a motion in this example, it cannot be overemphasized that it is good also as a configuration which recognizes the configuration of the body in the picturized image or either of the motions.

[0061] the configuration of the body in the image which was picturized as mentioned above according to this example ·· and ·· or with the recognition section of operation which recognizes a motion the configuration of the body recognized by the recognition section of operation ·· and ·· or with the display which displays a motion The criteria image memory which accumulates the image picturized to the time amount before the image saved in the frame memory which saves the image picturized in the image pick-up section, and the frame memory as a criteria image is prepared. In the recognition section of operation The image in a frame memory, By extracting a difference with the criteria image accumulated into criteria image memory If a user goes to the image pick-up section, for example, directions are given according to a gesture, the given gesture can choose the virtual switch which it was displayed on the display screen, for example, was displayed on the display screen according to a gesture, and will not need input units, such as a mouse, but actuation of a very simple device of it will be attained.

[0062] (The 3rd example) The appearance of the 3rd example of the interface device by this invention is the same as that of drawing 8 shown in the 2nd example, and only a part which explains the same part as the 2nd example using drawing 8 and drawing 10 , in addition is different is shown after drawing 14 .

[0063] Drawing 14 shows the detail block diagram of the 3rd example. The image inputted from CCD camera 3 is stored in a frame memory 31. It judges whether the recognition section 32 of operation is the configuration of a fist where the part which is equivalent to a user's hand, for example is extracted out of the image stored into the frame memory 31, and the

configuration shows drawing 10 (b) whether it is the configuration of 1 finger as shown in drawing 10 (a).

[0064] Drawing 15 shows the detail of the recognition section 32 of operation, and explains the detail actuation using drawing 16 - drawing 20 . First, the profile extract section 321 The profile configuration of the body which exists in an image is extracted. A profile configuration can be easily extracted by carrying out binarization of the image and extracting the edge as a concrete example of an approach. Drawing 17 (a) is an example of the extracted border line, and the part of a hand shows the configuration of 1 finger.

[0065] Next, as a border line is followed in the direction of the arrow head of drawing (counterclockwise rotation) with the start point s as the starting point in drawing and the profile configuration of the body extracted by the profile extract section 321 as shown in drawing 17 (a) is shown in drawing 19 , the profile wave operation part 322 The include angle theta from the horizontal line of the border line in each point x on a border line is extracted as a function to the distance l from a start point s. The coordinate of each point on the border line corresponding to distance l is used as a table, and it saves at a translation table 324 at the same time it changes wholly the distance l as shown in drawing 17 (b) into a wave configuration the bottom as a time-axis. The configuration filter 1 and the configuration filter 2 which are shown in 3231 and 3232 are a filter which passes the band corresponding to the irregularity of the part of the hand in the profile wave shown in drawing 17 (b), respectively, and the irregularity of the part of a finger.

[0066] With the configuration filter 1, as shown in drawing 17 (c), drawing 17 (b) It is changed into the smooth configuration wave only reflecting the irregularity of the part of a hand. With moreover, the configuration filter 2 As shown in drawing 17 (d), it is changed into the configuration wave only reflecting the irregularity of a finger, and differentiates with differentiators 3251 and 3252, respectively, and, finally the configuration differential wave shown in drawing 17 (e) and drawing 17 (f) is acquired. Judging whether the configuration judging section 3262 is the configuration of a fist where it is shown in drawing 10 (b) again whether the profile configuration of the part of a hand is a configuration of 2 fingers as shown in drawing 10 (a), the coordinate operation part 3261 calculates the barycentric coordinates of the profile configuration of the part said user's hand to coincidence. The coordinate operation part 3261 calculates the location where a big pulse shape in the configuration differential wave shown in drawing 17 (e) exists, and lc1 and lc2, and is the coordinate transformation table 324. It changes into c1 point shown in drawing 20 , and c2 point, and from the border line of the part of the hand from c1 point to c2 point, the center of gravity of the part of a hand is calculated and it outputs as a hand coordinate.

[0067] Moreover, the configuration judging section 3262 counts and outputs the number of the pulse shape with which the part of the finger in the configuration differential wave of drawing 17 (f) corresponds. That is, since two big pulse shape equivalent to the part of a finger exists,

in the case of drawing 17 (f), it judges with it being the configuration of 2 fingers as shown in drawing 10 (a), and outputs to it. As shown in drawing 18 (a), in the case of the configuration which grasped the hand, there is almost no irregularity of the part of a finger. Moreover, the output of the configuration filter 2 As are shown in drawing 18 (c), and it becomes a configuration wave without irregularity, therefore the output of a differentiator 3262 is also shown in drawing 18 (d) It becomes the configuration differential wave which does not have pulse shape, and the count of pulse shape can be set to 0, and it judges with it being the configuration of a fist as shown in drawing 10 (b), and can output. A simple threshold approach, a neural network, etc. can be used as an example of a concrete configuration of this configuration judging section 3262.

[0068] The icon generation section 34 of drawing 14 generates the icon image which should be displayed on a display based on the discernment result of the configuration of the hand by the configuration judging section 3262 in drawing 15 . For example, the icon of X mark if it is the configuration of a fist again, as shows the icon of an arrow head if the discernment result of the configuration of a hand is the configuration of 1 finger, as shown, for example in drawing 16 (a) to drawing 16 (b), for example is generated. A display and control section 33 controls the display position on the display of the icon generated by the icon generation section 34, and is the coordinate transformation section 331. It consists of the coordinate pars inflexa 332. The coordinate transformation section 331 performs conversion on the display coordinate of a display of the picturized image from a coordinate, and is the coordinate pars inflexa 332. The right-and-left location of the changed display coordinate is reversed. That is, conversion on the display coordinate of a display from the barycentric coordinates in the image of the part equivalent to a user's hand which the coordinate operation part 3261 in drawing 15 outputted is performed, a coordinate on either side is reversed, and an icon is displayed on a display. By this actuation, if a user moves a hand to the right, the same with having copied this actuation in the mirror, an icon will go by the shape of the display screen, and it will move to the right.

[0069] The example of actuation of this example constituted as mentioned above is shown below. Icon 203 displayed on the display 2 when the user faced to the device equipped with the interface device by this example and it moved by making a hand into the configuration of 1 finger, as shown in drawing 8 Arrow-head cursor moves to the location of the arbitration corresponding to a motion of a hand. Next, virtual switch 204,205,206 of the arbitration displayed on the display 2 If arrow-head cursor is moved, a hand is grasped and it is made a fist configuration by moving a hand upwards, the virtual switch is chosen and a command can be given to a host computer 1.

[0070] Moreover, if the configuration of a hand itself is iconified as an example of the icon to display as shown in drawing 16 (c) and (d), a motion and correspondence of an actual hand can be taken and it is intelligible. The profile configuration data of the hand which could register beforehand the image as shown in drawing 16 (c) and (d), and was specifically

extracted by the profile extract section can be reduced or expanded to the magnitude of arbitration, and can also be used as an icon image.

[0071] Thus, as the include angle of the border line to a horizontal line, i.e., a profile wave, if a user goes to the image pick-up section of an interface device, for example, this example gives directions according to a gesture, the image pick-up section will picturize a user's image, will extract the profile of a user's image, and will be changed by setting an axis of abscissa as the die length of the border line which made the reference point on a profile the start point. This profile wave is changed into the configuration wave which expresses the shape of toothing of a finger with the configuration filter constituted with the band pass filter of a predetermined band, for example, the band pass filter equivalent to the irregularity of a finger, while it calculates a location with a hand, only counts the pulse number which exists in this configuration wave, and can make the number of the finger currently sent, i.e., the configuration of a hand, judge correctly. The virtual switch which the given gesture was displayed on the display screen based on a location and a configuration of this sort, for example, was displayed on the display screen cannot be chosen according to a gesture, and input units, such as a mouse, are not needed, but actuation of a very simple device is attained.

[0072] (The 4th example) The 4th example of this invention is explained with reference to a drawing. Drawing 26 shows the block diagram of the 4th example of an interface device.

[0073] drawing 26 -- setting -- 41 -- an input means and 42 -- a cursor storage means and 43 -- a body storage means and 44 -- a display means and 45 -- an interaction judging means and 45a -- a distance count means and 45b -- for a movement vector calculation means and 45e, a configuration judging means and 45f of a study means and 45g are [a recognition means of operation and 45c / a comprehensive judgment means and 45d / a coordinate transformation means and 46] look input means.

[0074] In drawing 26 , an operator operates it to the input means 41, and it is based on said actuation result. The representation point coordinate and the configuration where the cursor storage means 42 represents the location in the virtual space of cursor are changed and memorized. The display means 44 is based on the representation point coordinate and the configuration of representing the location in the virtual space of the virtual body which the representation point coordinate and the configuration of representing the location in the virtual space of the cursor which the cursor storage means 42 memorizes, and the body storage means 43 memorize. Said cursor and said virtual body It two-dimensional-displays or displays in three dimensions.

[0075] The look input means 46 detects the location of the look of the operator on said display. Distance count means 45a calculates the distance in the virtual space of cursor and a virtual body by being based on the coordinate of the representation point memorized for the cursor storage means 42 and the body storage means 43. Of operation recognition means 45b recognizes actuation actuation based on the contents memorized for the cursor storage means

42 and the body storage means 43. 45d of movement vector calculation means computes the migration direction and migration length of cursor in a virtual space. It judges whether configuration judging means 45e is suitable for the configuration of cursor and the configuration of a virtual body to cause an interaction. 45f of study means memorizes the location of a said cursor and said virtual body when comprehensive judgment means 45c causes the interaction between cursor and a virtual body, and the relation of a configuration, and they output whether the current condition is similar to the condition of having caused the interaction in the past.

[0076] The distance of a between [the cursor to which distance count means 45a outputs comprehensive judgment means 45c, and a virtual body], The recognition result which of operation recognition means 45b has recognized, and the migration direction and migration length of cursor which 45d of movement vector calculation means computes, The location of the look which the look input means 46 detects, and the judgment result of configuration judging means 45e, It judges whether said cursor and said virtual body interact based on a similar degree with the interaction of the past which 45f of study means outputs, and said representation point coordinate and configuration of cursor or said virtual body are changed according to the result of an interaction. When the interaction judging means 45 causes an interaction, 45g of coordinate transformation means performs coordinate transformation so that both location may approach the coordinate in the virtual space of the cursor and the target virtual body which distance count means 45a uses for distance count.

[0077] Drawing 22 (a) and (b) are the things of the manipulator configuration of two fingers with the gestalt of operation of the first of the cursor used for the interface device of this invention. In drawing 22 , the condition to which (a) opened the finger, and (b) are in the condition which closed the finger. Drawing 22 (c) and (d) are the things of the manipulator configuration of 2 finger 2 joint with the gestalt of operation of the second of the cursor used for the interface device of this invention. In drawing, the condition to which (c) opened the finger, and (d) are in the condition which closed the finger. Drawing 22 (e) and (f) are the gestalten of operation of the third of the cursor used for the interface device of this invention, and are the thing of the shape of a note of five fingers. In drawing 22 , the condition to which (e) opened the hand, and (f) are in the condition which closed the hand. Drawing 23 (a) and (b) are the examples of the body in the virtual space used for the interface device of this invention ((a) is a cube and (b) is a flat-surface object).

[0078] Actuation of the interface device constituted as mentioned above is explained. This example assumes the actuation which moves cursor like drawing 22 into the virtual space of a three dimension, and an operator holds a virtual body like drawing 23 which exists in said virtual space, and moves. Actuation of an operator is performed to the input means 41.

[0079] Here, the command input by a means or a camera as shown in drawing 27 (a) · (c), a keyboard, speech recognition, etc. can be used for an input as an input device which inputs

the information for changing the location or configuration of cursor. Drawing 27 (a) is a mouse and operates cursor by migration of a mouse body, the click of a carbon button, etc. Drawing 27 (b) is a data glove, equip people's hand with it, makes the location in the real space of the joint angle of a finger, or a data glove reflect in the location and configuration of cursor, and operates cursor. Drawing 27 (c) is a joy stick and operates cursor according to actuation of a lever, and concomitant use with a manual operation button. In using a camera, a part of body or body (hand etc.) is picturized with a camera, and it reads the configuration and location of a hand.

[0080] Drawing 28 shows the gestalt of 1 implementation of the configuration extract at the time of picturizing only a hand with a camera. Drawing 28 (a) is the example which picturized the hand with the camera. It is drawing 28 (b) which carried out binarization of the brightness of each pixel of the image of drawing 28 (a). In drawing 28 (b), the judgment of the degree of closing motion of a hand is attained with the ratio of the die length of the side of rectangular length and the die length of the horizontal side which are circumscribed to a **** field etc., and the input of a location and distance is attained from the barycentric coordinates and area of the whole black pixel. The input means 41 outputs said contents of actuation (the movement magnitude of cursor, the amount of modification of a cursor configuration, etc.) to the cursor storage means 42.

[0081] The cursor storage means 42 memorizes the coordinate and configuration in the virtual space of the representation point of the cursor memorized with a cursor storage means based on the contents of actuation which the input means 41 outputted. As a representation point, the barycentric coordinates (X_0, Y_0, Z_0) of cursor are used as a representation point.

[0082] In addition, as a representation point, a main coordinate of each side, a coordinate of top-most vertices, etc. which constitute cursor may be used. In the case of drawing 22 (a), in the spacing d of two fingers, drawing 22 (b), and (c), let as a configuration interior angle thetan (the number whose n is a joint: when thetan becomes small, the condition that a joint bends is shown) of the joint of each finger be storage information. In addition, as a configuration, the fingertip of each finger, the coordinate in the virtual space of each joint, etc. may be used.

[0083] The body storage means 43 memorizes the coordinate and configuration of a representation point of a virtual body in the virtual space shown in drawing 23 set as the object of actuation. As a representation point, they are the barycentric coordinates (cube: (X_1, Y_1, Z_1), flat-surface object : (X_2, Y_2, Z_2)) of a virtual body.

It uses as a representation point. In addition, as a representation point, a main coordinate of each side, a coordinate of top-most vertices, etc. which constitute a virtual body may be used. The parameter alpha showing the configuration beforehand defined as a configuration is memorized as a configuration (a cube is defined as alpha= 1 and a flat-surface object is defined as alpha= 2 here). In addition, a top-most-vertices coordinate etc. may be used as a

configuration.

[0084] The display means 44 indicates the image at which it looked from the view which specified the virtual space beforehand based on the cursor which the cursor storage means 42 and the body storage means 43 memorize, the location of a virtual body, and the information on a configuration by two-dimensional. The example of a display of a display means is shown in drawing 29 (a). If an operator operates it, the display position or configuration of cursor will change and an operator will continue actuation based on the display.

[0085] The interaction judging means 45 judges whether cursor has held the body, whenever a cursor location changes (existence of an interaction), and when cursor judges that the body has been held, it also moves the coordinate of a virtual body in accordance with migration of cursor. Distance count means 45a calculates the barycentric coordinates (X1, Y1, Z1) of the virtual body memorized for the barycentric coordinates (X0, Y0, Z0) and the body storage means 43 of the cursor memorized for the cursor storage means 42, and the distance of (X2, Y2, Z2).

[0086] An of operation recognition means 45b means recognizes actuation of "holding" as actuation registered beforehand, using change of the configuration of cursor. It is recognized as actuation and recognized as the actuation "holds" the condition the condition that the spacing d of two fingers continues decreasing "is held" in the case of the cursor of drawing 22 (a) that include-angle thetan of all fingers continues decreasing in the case of the cursor of drawing 22 (b) and (c). In addition, a serial change of the parameters (said d, thetan, etc.) with which a configuration is expressed as the recognition technique of operation may be used as the recognition technique, after making specific actuation learn beforehand using the time series pattern recognition technique (table matching, DP matching, a HIDOUN Markov model (HMM), RIKARENTO neural network, etc.).

[0087] 45d of movement vector calculation means computes the migration direction and movement magnitude of cursor in a virtual space by using change of the barycentric coordinates (X0, Y0, Z0) of cursor. for example, barycentric coordinates (X0, Y0, Z0) t of the present time of day t Barycentric coordinates t-1 in front of 1 time of day (X0, Y0, Z0) difference -- let the direction and magnitude of a vector be the migration direction and movement magnitude of cursor.

[0088] Configuration judging means 45e judges (whether the configuration of cursor is suitable to cause a virtual body and an interaction) for whether it is a configuration with the suitable configuration of the cursor memorized for a cursor storage means to hold the virtual body of the configuration memorized for a body storage means. Here, when the value of the parameter alpha showing an objective configuration is 1, the condition that the finger of cursor is open is made into a suitable condition. In the case of the cursor of drawing 22 (a), as decision of the condition that the finger of cursor is open, the value of d is the maximum dmax of d, for example. It considers as the case of being larger than the mean value of 0, and, in

drawing 22 (b) and (c), each joint angle thetan considers all [mean value / each / of maximum thetan max and 0] as the case of being large.

[0089] When the value of the parameter alpha showing an objective configuration is 0, the condition that spacing of the fingertip of cursor is narrow is made into a suitable condition. In the case of the cursor of drawing 22 (a), as decision of the condition that the fingertip of cursor is narrow, the value of d is the maximum dmax of d, for example. It considers as the case of being smaller than the mean value of 0, and, in drawing 22 (b) and (c), each joint angle thetan is each maximum thetan max. All [mean value / of 0] are considered as the case of being small. in addition -- if the parameter (d or thetan) showing the cursor configuration when having held in the condition that cursor contacts a virtual body in a virtual space as a diagnosis of a configuration is memorized beforehand and it is in agreement in the range whose value of each parameter is **30% It holds. It can perform judging that it is suitable for actuation etc.

[0090] The look input means 46 detects an operator's look, and computes the coordinate (coordinate of a fixation point) at which an operator gazes on the screen which the display means 44 displays. The fixation point on said screen is computed by measuring the location of an operator's head using a camera etc. using the approach of detecting the sense of an operator's pupil, using a CCD camera, a photosensor, etc. as a detection means of a look etc.

[0091] When, as for 45f of study means, cursor judges [comprehensive judgment means 45c] that the virtual body has held The relative physical relationship (vector which connects the center of gravity of cursor and the center of gravity of a virtual body) of the location of the parameter (d or thetan) showing the configuration of ** cursor, the parameter alpha showing the configuration of the held virtual body, and said cursor and the location of said virtual body is memorized. The physical relationship of the center of gravity of the parameter showing the configuration of a current virtual body, the parameter showing the configuration of a surrounding virtual body, and current cursor and the center of gravity of a surrounding virtual body When the body has been held in the past, in being near, it judges that it is similar with the past situation, and outputs 1 (for example, when the value of the element showing each parameter and physical relationship of each dimension of a vector is in agreement in the past value and **30% of range etc.), and in the case of others, 0 is outputted. In addition, the relative physical relationship of the location of the parameter showing the configuration of the cursor in the case of having held the body, the parameter alpha showing the configuration of the held virtual body, and said cursor and the location of said virtual body may be learned using a neural network etc. in the past as other study means. Moreover, it can also learn including the physical relationship of the fixation point coordinate on the screen detected with the look detection means 46 as an item to learn, and the coordinate on the display screen of cursor etc.

[0092] When the body has been held, coordinate transformation of the 45g of the coordinate

transformation means is carried out so that the distance of the cursor in a virtual space and the target virtual body may approach the coordinate which a distance count means uses for distance count (when an interaction is caused). For example, when each coordinate when cursor has held the virtual body is (100, 150, 20), and (105, 145, 50), a coordinate transformation means changes like [Z coordinate / of a difference / largest] (1) type among each axis of coordinates.

[0093] $Z'=0.8xz$ [ ] ..... (1) ·· here, the Z coordinate of the center of gravity of the cursor which, as for z, a coordinate transformation means considers as an input, and a virtual body, and Z' show the Z coordinate which a coordinate transformation means outputs.

[0094] In this case, the value of X coordinate and the value of Y coordinate are not changed. Moreover, since the value memorized for a cursor storage means and a body storage means does not change, the screen which a display means displays does not change. If actuation which an operator holds is performed by performing the above conversion even when the distance in a virtual space is separated, the cursor in the case of performing distance count and the distance between virtual bodies will become small after it, and a distance count means will become possible [calculating the distance near the depth perception which an operator perceives].

[0095] When comprehensive judgment means 45c is below the criteria that the distance of a between [the cursor which distance count means 45a outputs, and a virtual body] defined beforehand, When of operation recognition means 45b has recognized the actuation registered beforehand of "holding" It judges with the interaction of "holding" having occurred and the value of the barycentric coordinates of the virtual body which is memorized for the body storage means 43 until an interaction is completed and which is held "is held" henceforth is made in agreement with the barycentric coordinates of cursor. Here, a value with actually larger cursor and a body than the distance which can contact in a virtual space is sufficient as said reference value defined beforehand. For example, the actuation which an operator will hold if the distance of a virtual body and cursor is below the reference value of said distance in the case of drawing 25 (arrangement of drawing 24) is directed for the input means 1, and if the actuation which of operation recognition means 45b holds is recognized, it will become possible to hold a virtual body and to move.

[0096] Moreover, when, as for comprehensive judgment means 45c, two or more virtual bodies exist below in the criteria of said distance, It is aimed only at the body below criteria (for example, 90 degrees) with the include angle of the segment (wavy line) which ties cursor and a virtual body as shown in drawing 29 (b), and the migration direction (arrow head) of the cursor which 45d of movement vector calculation means computes to make. The judgment of an interaction which took the migration direction of cursor into consideration in actuation of an operator is attained (what is most located in the upper part among 3 bodies by a diagram is chosen).

[0097] Moreover, about the migration length of cursor, when migration length is larger than the migration length criteria defined beforehand, an interaction is not caused. Thereby, when cursor is only being moved, it becomes possible not to cause the interaction which an operator does not mean.

[0098] Moreover, as shown in drawing 29 (c), when two or more virtual bodies are meeting said criteria, comprehensive judgment means 45c sets the virtual body near the location of the fixation point which the look input means 46 detects as the object "to hold" (the body of the left-hand side near "+" mark which means a fixation point by a diagram is chosen). This becomes possible to choose an object easily using an operator's look.

[0099] Moreover, as shown in drawing 29 (d), when the body which approached on the screen exists, comprehensive judgment means 45 c sets the virtual body which is in agreement with the configuration of the cursor which configuration judging means 45e judged as the object "to hold" (since spacing of the finger of cursor is narrow by a diagram, it judges that a flat-surface object is suitable as an object of the actuation "to hold", and a flat-surface object chooses). This is enabled to choose the virtual body which an operator means with the configuration of cursor, and actuation becomes easy by matching the cursor configuration of which it is easy to be reminded when an operator holds a virtual body.

[0100] Moreover, comprehensive judgment means 45c chooses preferentially the virtual body it was judged that was similar with the case where 45f of study means has held the body in the past. Thereby, an operator reproduces decision near the actuation performed in the past, and becomes possible [improving operability].

[0101] Thus, this example can raise operability in the interface which performs an interaction with the virtual body using the cursor in a virtual space by determining it based on the example of the actuation in actuation of an operator, a look, or the past rather than determining the existence of generating of the interaction of the cursor which an operator operates in a virtual space, and the virtual body in a virtual space only in the distance of cursor and a virtual body.

[0102] In addition, although this example explained using the actuation which holds a virtual body, using cursor as an interaction, the treatment same about actuation of the directions (pointing) to a virtual body, a collision and friction, a blow, remote operation, etc. otherwise is possible. Moreover, the same effectiveness is acquired, when a virtual space is two-dimensional space, or also when a display means uses a three-dimension three dimentional display display etc. Moreover, you may realize using the software on a computer, using hardware as an implementation means.

[0103] This example the existence of generating of the interaction of the cursor which an operator operates in a virtual space, and the virtual body in a virtual space as mentioned above Only the distance between components does not determine said cursor and said virtual body in a virtual space. When a comprehensive judgment means judges the existence of

generating of an interaction by actuation of the cursor which the distance and the recognition means of operation between the representation points which a distance count means computes recognize It becomes possible to cause an interaction also to the object with which the distance in a virtual space is not necessarily close, and it becomes possible to offer the good input/output interface of operability. Moreover, since it is not necessary to calculate all the distance between components for said cursor and said virtual body in a virtual space like the conventional contact diagnosis, computational complexity is mitigated, and it becomes possible to attain improvement in the speed of processing.

[0104]

[Effect of the Invention] This invention can control easily the information displayed on the screen by the configuration of a hand, and the motion in the information displayed in the screen with sufficient operability as mentioned above by indicating by cursor on a screen by making into a special configuration the description of the configuration of the configuration of an operator's hand, or the hand which has recognized the motion again and has been recognized.

[0105] Furthermore, while displaying on a screen and indicating by cursor by making the description of the configuration of a hand into a special configuration, the interface whose operability of actuation of directing or holding a display object improved further is realizable by making serially automatically the judgment of an interaction which met the intention of an operator in relation with display objects other than the cursor display.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The external view of the interface device by the 1st example of this invention

[Drawing 2] The detail block diagram of the interface device by the 1st example of this invention

[Drawing 3] (a) - (c) Drawing showing the example of the configuration of the hand judged with this interface device

[Drawing 4] Drawing showing the example of a detail of the configuration discernment means of the interface device by this example

[Drawing 5] Drawing showing an example of the operation by the image difference operation part of this example

[Drawing 6] (a) - (d) Drawing showing the example of the icon which the icon generation section of this example generates

[Drawing 7] (a) - (c) External view showing the example of the interface device by this example of operation

[Drawing 8] The external view of the interface device by the 2nd example of this invention

[Drawing 9] The detail block diagram of the interface device by the 2nd example of this invention

[Drawing 10] (a) and (b) Drawing showing the example of the configuration of the hand judged with this interface device

[Drawing 11] Drawing showing the detail example of the recognition section of the interface device of this example of operation

[Drawing 12] Drawing showing an example of the operation by the image difference operation part of this example

[Drawing 13] (a) - (d) Drawing showing the example of the icon which the icon generation section of this example generates

[Drawing 14] The detail block diagram of the interface device by the 3rd example of this invention

[Drawing 15] Drawing showing the recognition section of the interface device of the 3rd example by this invention of operation

[Drawing 16] (a) - (d) Drawing showing the example of the icon displayed on the display screen with the interface device by this example

[Drawing 17] (a) - (f) Drawing showing actuation of the recognition section of the interface device by this example of operation

[Drawing 18] (a) - (f) Drawing showing actuation of the recognition section of the interface device by this example of operation

[Drawing 19] Drawing showing actuation of the recognition section of the interface device by

this example of operation

[Drawing 20] Drawing showing actuation of the recognition section of the interface device by this example of operation

[Drawing 21] The block diagram showing the interface device in the 4th example of this invention

[Drawing 22] (a) Drawing showing the condition that cursor opened in an example of the cursor used for the interface device of this example

(b) Drawing showing this closing ******

(c) Drawing showing the condition that cursor opened in other examples of the cursor used for the interface device of this example

(d) Drawing showing this closing ******

(e) Drawing showing the condition that cursor opened in the example of further others of the cursor used for the interface device of this example

(f) Drawing showing this closing ******

[Drawing 23] (a) Drawing showing the form of an example of the virtual body used for the interface device of this example

(b) Drawing showing the form of other examples of this virtual body

[Drawing 24] (a) The front view showing the cursor of a virtual space, and arrangement of a virtual body

(b) The side elevation showing the cursor of a virtual space, and arrangement of a virtual body

[Drawing 25] Drawing showing the example of a display of the virtual space for explaining this example

[Drawing 26] The block diagram showing an example of the interface device of this example

[Drawing 27] (a) Drawing showing an example of the input unit in the input means used for the interface device of this example

(b) Drawing showing other examples of the input unit in the input means used for the interface device of this example

(c) Drawing showing the example of further others of the input unit in the input means used for the interface device of this example

[Drawing 28] (a) Drawing showing an example of the image which picturized the hand using the camera of this example

(b) Drawing showing an example which carried out binarization of the image which picturized the hand using the camera of this example

[Drawing 29] (a) Drawing showing an example of the screen which the display means used for the interface device of this example displays

(b) Drawing showing the second example of this display screen

(c) Drawing showing the third example of this display screen

(d) Drawing showing the fourth example of this display screen

[Drawing 30] Drawing showing the conventional interface device

[Description of Notations]

1 Host Computer

2 Display

3 CCD Camera

21 Frame Memory

22 Configuration Discernment Means

23 Display and Control Section

24 Icon Generation Section

25 Criteria Image Memory

26 Renewal Section of Criteria Image

31 Frame Memory

32 Recognition Section of Operation

33 Display and Control Section

34 Icon Generation Section

41 Input Means

42 Cursor Storage Means

43 Body Storage Means

44 Display Means

45 Interaction Judging Means

45a Distance count means

45b Recognition means of operation

45c Comprehensive judgment means

45d Movement vector calculation means

45e Configuration judging means

45f Study means

45g Coordinate transformation means

200 Icon

201,202 Menu

203 Icon

204,205,206 Virtual switch

221 Image Difference Operation Part

222 Profile Extract Section

223 Configuration Discernment Section

224 Location Detecting Element

225 Form Status Change-ized Discernment Section

231 Coordinate Transformation Section

232 Coordinate Pars Inflexa

261 Timer

262 Renewal Section of Image

321 Profile Extract Section

322 Profile Wave Operation Part

324 Coordinate Table

331 Coordinate Transformation Section

332 Coordinate Pars Inflexa

3231 Configuration Filter 1

3232 Configuration Filter 2

3251 Differentiator

3252 Differentiator

3261 Coordinate Operation Part

3262 Configuration Judging Section